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**Abstract**

In this paper, we examine international linkages in inflation and short-term interest rates using a global sample of OECD and emerging economies. Using a Bayesian global vector autoregression (GVAR) model, we show that for short-term interest rates both movements in inflation and output play an important role. In advanced countries, however, international factors such as foreign interest rates appear as an important driver of local interest rates. For inflation, we also find evidence for the importance of global factors, such as price developments in other countries, oil prices and the exchange rate. Again, this impact of global factors appears predominately in advanced countries.

Keywords: Monetary policy; Inflation; Global VAR

JEL codes: E40; E43; E44

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# 1 Introduction

To which extent have central banks (CBs) to consider global developments when formulating their monetary policy and are they actually watching external factors? In the decisions of CBs, inflation plays a prominent role. Many studies investigated how CBs react to shifts in inflation and how, in turn, CBs monetary policy interest setting shapes inflation. VAR modelling has become a common method to study this inflation - monetary policy nexus. However, those studies generally neglect the likelihood that guiding indicators and policy decisions of CBs may be subject to a number of global influences.

Monetary authorities underlined recently that their guiding indicator, inflation, has become increasingly influenced by global factors (BIS, 2015; ECB, 2017). There are studies presenting evidence in favor of correlation in price developments across trading partners (Lombardi and Galesi, 2009; Auer et al., 2017) or a common component across countries (Ciccarelli and Mojon, 2005; Mumtaz and Surico, 2012).

Furthermore, the necessity for central banks to base their policy decisions not only on domestic developments but also on international ones and the potential spillovers from other countries' monetary policy, notably that of the USA or the euro area, has been stressed by Taylor (2014).[1]Empirically, Chatterjee (2016) identifies a common factor in monetary policies of the major advanced economies.

In view of this evidence of likely global forces on the single elements of the inflation - monetary policy nexus, we think it is highly important to consider such global influences when studying the relationships in this nexus in a VAR model. While existing work in the field (e.g., Svensson, 1999; Bernanke et al., 2005; Primiceri, 2005) mostly assumed that countries were isolated economies, we explicitly wish to account for the likelihood of international linkages and therefore use a global vector autoregressive (GVAR) model. In this set up we are able to consider (i) external linkages of inflation which may, for example, arise from price spillovers from trading partners, and (ii) global linkages of monetary policy rates which may arise, for example, when central bankers watch the development of the business cycle and of interest rates in other countries since those might matter for domestic exchange rates due to financial linkages. Since the GVAR uses a Bayesian algorithm, we also can account for variable uncertainty and select models with high probability.

Our empirical study covers all major trading economies, 24 OECD economies plus the major emerging market economies,[2] using quarterly data for the period from 1995 to 2016. More specifically we collect data for euro area (EA) countries (Austria, Belgium, Germany Finland, France, Greece, Ireland, Italy, Netherlands Portugal, Slovakia and Slovenia), other advanced economies (Australia, Canada, the USA, the UK, Switzerland, Japan, Norway and Sweden), Central, Eastern and Southeastern Europe (CESEE, Czech Republic, Hungary and

[1]Taylor (2007) proposes that central banks should explicitly watch the events in other economies and observe monetary decisions of other central banks and proposes that monetary authorities should ideally act in a cooperative manner

[2]The few other studies with an open economy set up either focus on a smaller sample of countries, thus omitting potentially important trade and financial flows (Dees et al., 2007; Chin et al., 2018; Kamber and Wong, 2018) or a different time period when monetary policy was less focused (Pesaran et al., 2004; Galesi and Sgherri, 2009)

Poland), and major emerging markets (EMEs, Brazil, Mexico, China, India, Russia and Turkey). In this set-up:

i we study how the system reacts to inflation shocks by looking at impulse responses, notably of short-term interest rates and output. Unlike in most studies, we impose no timing assumption in order to identify the results from the GVAR estimation. Instead we calculate generalized impulse response functions which does not require heavy assumption often not supported by the reality. This allows us to remain within a rich model setup.

ii we examine the determinants of inflation on the one hand, and short-term money market interest rates - our proxy for monetary policy - on the other hand, by looking at forecast error variance decompositions (FEVD). This analysis permits us

- to show the contribution of domestic vs global factors in explaining inflation and interest rates.

- Furthermore the rich model setup allows us to disentangle inflation and interest rate determinants into several categories. Thus we examine the impact of domestic demand, monetary policy, currency fluctuations and external price variations on inflation. And for monetary policy, the impact of inflation, output and currency development as well as of foreign interest rates and foreign output development is tested.

- We can compare what drives inflation and monetary policy in the short run and in the long run.

- We are able to look at differences in inflation and monetary policy determinants between countries and country groups (advanced countries, EMEs, CESEE).

We know of no other study that addresses these issues in such a comprehensive scope.[3]

Our analysis provides a number of interesting results: First, our analysis suggests that changes in domestic inflation lead to an increase in short-term interest rates and consequently to a decrease in output growth. The reaction of monetary policy in advanced countries is less pronounced compared to CESEE and EMEs. As practically all economies in our sample have adopted inflation targeting (IT) we interpret this as evidence that particularly in EMEs and CESEE monetary authorities are highly committed to the set target.

Second, from the FEVD, we see that foreign factors account for 50 per cent of forecast error variance associated with inflation in the short-run and for 80 per cent in the long-run. The global impact on inflation is much smaller in CESEE and EMEs. Foreign prices explain 55 per cent of inflation in advanced countries. Currency and oil price developments affect inflation of all countries. The second most important factor for inflation in the long-run is monetary policy, in several EMEs this is even the most important factor.

[3]Only Lombardi and Galesi (2009) study inflation in a similar setting using a GVAR model, but an outdated data set and smaller country coverage. Recently, Feldkircher and Siklos (2018) also uses a similar econometric approach but focuses on the link between inflation and inflation expectations for a large set of countries.

Third, the FEVDs reveal that in advanced countries, global factors account for over 50 per cent of forecast error variances associated to short-term interest rates in the long-run, whereas in the short-run domestic factors dominate. In contrast, the influence of domestic factors on interest rates dominates in EMEs irrelevant whether short or long-run. In all regarded economies, interest rates follow price development, output development and currency fluctuations (except for the USA and euro area). This suggests that monetary policy is concerned about these factors. Finally, our results show that in all countries, particularly in advanced ones, interest rates follow foreign output and interest rates, which proposes that monetary policy considers such global trends.

Our study has important policy implications. We see that in a globalized world, CBs have a challenging job. One of their main policy objective, price stability, is increasingly influenced by foreign prices and not primarily by their interest policy. Furthermore, the example of the advanced countries shows that CBs will have to consider more and more developments in foreign output, prices and interest rates the more open countries become. Our study provides evidence that CBs not only discuss such issues but actually seem to consider them in their policy decisions.

The paper is organized in the following way. Section 2 presents the econometric model. Section 3 outlines our hypotheses reviews closely related literature. Section 4 discuss the results and section 5 concludes.

## 2 The Model

We employ a Bayesian GVAR model in order to capture cross-country linkages in our sample. This framework is perfectly suited for our research idea since it allows us to be flexible in defining individual country models, however, it also permits us to uncover potential dependencies across countries.

The GVAR model builds on a sequence of $N+1$ country-specific VAR models that represent the relationship between domestic and international macroeconomic factors jointly.[4] The model for a typical country $i$ includes the following variables based on quarterly frequency: real yoy GDP growth ($\Delta y$), yoy inflation based on the CPI index ($\pi$), short-term nominal interest rates (3-months money market rates, $i$) as a proxy for monetary policy, the term spread (difference between 10-year government bond yields and short-term interest rates, $sp$), equity prices ($eq$), the real exchange rate vis-á-vis the US dollar ($er$) and yoy change in the prices of the crude oil Brent ($poil$)[5]

[4] Our sample covers all major economies. These heavily trade with each other and cover major world trade and financial linkages. The export shares with the rest of the sample reach 60 to above 90 per cent. Practically all countries practice inflation targeting.

[5] Our system contains equity prices and term spreads to represent the financial side of the economy. Recent literature stresses the importance of the global financial cycle (Miranda-Agrippino and Rey, 2018) that amplifies cross-country spillovers. We use financial variables to account for their potential role as shock propagators. Additionally, term spreads serve as a measure of unconventional monetary policy following Baumeister and Benati (2013) and Chen et al. (2016), among others. The time line of our analysis intercepts with the so-called binding zero lower bound period when policy rates were at/near zero and quantitative easing was the only way for central banks to provide some stimulus. As monetary policy aims to lower long-term yields, term spread can serve as a measure of monetary policy during times of unconventional instruments. New approaches

For countries where interest rates stayed at the zero lower bound such as the euro area, Japan, the UK and the USA, we use shadow interest rates of Krippner (2013). These mirror actual interest rates during normal periods and can become negative when the zero lower bound is binding but the central bank provides additional stimulus through unconventional monetary policy measures.

We collect all variables for country $i$ in a $k_i \times 1$ vector $x_{it}$

$$\boldsymbol{x}_{it} = (\Delta y_{it}, \pi_{it}, i_{it}, sp_{it}, eq_{it}, er_{it})'. \tag{1}$$

Depending on data availability and country-specifics, this specification can vary for each country.

We then assume that the dynamics of the $k_i$ endogenous variables in country $i$ are described by the following VARX($p=2$, $q=2$) model,

$$\boldsymbol{x}_{it} = \sum_{j=1}^{p=2} \boldsymbol{A}_{ij} \boldsymbol{x}_{it-j} + \sum_{s=0}^{q=2} \boldsymbol{B}_{is} x^*_{it-s} + \boldsymbol{\varepsilon}_{it}, \tag{2}$$

with $\boldsymbol{A}_{ij}$ $(j = 1, \ldots, p)$ being $k_i \times k_i$-dimensional coefficient matrices. $\boldsymbol{B}_{is}$, $(s = 0, \ldots, q)$ are coefficient matrices of dimension $k_i \times k_i^*$ associated with the weakly-exogenous variables and $\boldsymbol{\varepsilon}_{it}$ is a normally distributed vector error term with a time-varying variance-covariance matrix $\boldsymbol{\Sigma}_{it}$.

The weakly exogenous or international variables $\boldsymbol{x}^*_{it}$ are the main mechanism through which spillovers and feedback is passed on between countries. These are simply computed as a weighted average of the other countries' endogenous variables:

$$\boldsymbol{x}^*_{it} = \sum_{j=0}^{N} w_{ij} \boldsymbol{x}_{jt}, \quad \text{for} \quad i \in \{0, \ldots, N\}, \tag{3}$$

Here $w_{ij}$ denotes a set of bilateral weights that reflect economic interaction between countries $i$ and $j$, normalized to sum up to unity.[6] As is common in the literature using GVARs, $w_{ij}$ are based on bilateral trade flows. More precisely, we use annual data from the World Input Output Database (WIOD), averaged over the period from 2000 to 2014.[7] Recently, other weights based on, e.g., financial flows have been proposed in the literature (see, e.g., Eickmeier and Ng, 2015). However, Feldkircher and Huber (2016) present a sensitivity analysis with respect to the choice of weights in Bayesian GVAR specifications and show that trade weights yield a reasonable model fit.

to measure monetary policy generally focus on the yield curve as a vehicle through which monetary policy materializes (Inoue and Rossi, 2018). Moreover, there is evidence on interconnectedness of long-term interest rates across advanced economies (Chin et al., 2018).

[6] For simplicity we assume here that all countries feature the same number of endogenous variables in $\boldsymbol{x}_{jt}$. In the empirical application the dimension of $\boldsymbol{x}^*_{it}$ depends on the country.

[7] In this way, the weight of a foreign country$_j$'s variable corresponds to its share in country$_i$'s imports. The data is retrieved from `http://www.wiod.org/home` and only available up until 2014. For a detailed description see Timmer et al. (2015).

A convenient feature of the GVAR framework is that the variable coverage can vary across countries. We include the respective foreign counterparts for all domestic variables $\boldsymbol{x}_{it}$ – with two exceptions. First, and to control for exchange rate movements in a broader sense, we include trade-weighted exchange rates in the USA where no domestic exchange rate (vis-à-vis the US dollar) exists.

The second exception relates to how we model monetary policy in the euro area. Following Georgiadis (2015) and Feldkircher et al. (2019) we introduce an "ECB" country model where monetary policy is determined by a simple Taylor rule. More specifically, the 3-month Euribor is regressed on purchasing power parity (PPP)-weighted averages of output and consumer price inflation of euro area countries. Euro area short-term interest rates enter then into all (also non-euro area) country models as a weakly exogenous variable. Last and in line with the bulk of the GVAR literature, we include oil price inflation (*poil*, Brent, in US dollar) as a global control variable that is assumed to be determined within the US country model (see e.g., Pesaran et al., 2004).

In what follows we relax the assumption of a homoskedastic error term to account for the relatively volatile time period under study: For many countries, the sample span includes a boom period (up until 2006) and a severe bust period (2008/09) followed by a diverse recovery. Also, the recent literature demonstrates that including stochastic volatility leads to improved forecasts (Dovern et al., 2016; Huber, 2016) and thus to more useful models.

Following Cogley and Sargent (2005) we can decompose $\boldsymbol{\Sigma}_{it}$ as follows

$$\boldsymbol{\Sigma}_{it} = \boldsymbol{U}_i \boldsymbol{H}_{it} \boldsymbol{U}_i', \tag{4}$$

where $\boldsymbol{U}_i$ is a $k_i \times k_i$-dimensional lower triangular matrix with unit diagonal and off-diagonal elements denoted by $u_{ij,n}$ $(j = 2, \ldots, k_i; n = 1, \ldots, j-1)$ and $\boldsymbol{H}_{it}$ is a diagonal matrix with $\boldsymbol{H}_{it} = \text{diag}(e^{h_{i1,t}}, \ldots, e^{h_{ik_i,t}})$. We assume that the log-volatilities $h_{ij,t}$ follow an AR(1) process,

$$h_{ij,t} = \mu_{ij} + \rho_{ij}(h_{ij,t-1} - \mu_{ij}) + \kappa_{ij,t}. \tag{5}$$

Hereby we let $\mu_{ij}$ denote the (unconditional) mean of the log-volatility, $\rho_{ij}$ is the persistence parameter and $\kappa_{ij,t}$ denotes a white noise error with variance $\varsigma_{ij}^2$.

To reduce estimation uncertainty we employ a Bayesian shrinkage prior to estimate coefficients and variance covariance parameters of the country models. More specifically, we follow Feldkircher and Huber (2016) and Feldkircher et al. (2019) and estimate the country VARs using the stochastic search variable selection (SSVS) prior of George and McCulloch (1993) adapted for the VAR case in George et al. (2008). The prior choice is guided by the nature of our wide sample of countries. It permits to account for parameter uncertainty at country level.

The SSVS prior falls into the category of spike and slab priors. One of the main problems in vector autoregressions is that of overparametrization. The GVAR framework, where the two-step procedure of first estimating the single country models and then stacking the estimated coefficients together, reduces the curse of dimensionality significantly. That said, even here a lot of parameters per country model have to be estimated. For a typical country this amounts to $6^2 + 6^3$ parameters plus a constant term and the stochastic volatility part.

Let us rewrite equation 2 stacking all autoregressive parameters into one matrix $C_i$:

$$x_{it} = C_i Z_{it} + \epsilon_{it}. \tag{6}$$

where $Z_{it} = (x'_{it-1}, x'_{it-2}, x^{*\prime}_{it-1}, x^{*\prime}_{it-2})'$. The SVVS prior placed on the vector of coefficients $c_i$ =vec($C_i$), now draws from a mixture of two normal distributions

$$c_{ij}|\delta_{ij} \sim \mathcal{N}(0, \tau^2_{ij,0})\delta_{ij} + \sim \mathcal{N}(0, \tau^2_{ij,1})(1 - \delta_{ij}). \tag{7}$$

Important is that $\tau^2_{ij,0} \gg \tau^2_{ij,1}$ which renders the first distribution effectively uninformative and the second one tightly centered around the prior mean, zero in our case. Using only the first distribution would thus lead to estimates that are close to a VAR estimated with maximum likelihood. These estimates, however, would be subject to over-parametrization issues.

To circumvent this behavior, a latent indicator $\delta_{ij}$ is introduced that pushes coefficients associated with irrelevant variables to zero. To decide which of the two priors becomes effective, we thus have to simulate $\delta_{ij}$ from its conditional posterior by drawing from a Bernoulli distribution with probability $p(\delta_{ij} = 1) = \frac{\mathcal{N}(c_{ij}|0,\tau^2_{ij,0})}{\mathcal{N}(c_{ij}|0,\tau^2_{ij,0}) + \mathcal{N}(c_{ij}|0,\tau^2_{ij,1})}$ within each sweep of the MCMC algorithm. Notice that if a given draw of $c_{ij}$ is small, it is thus more likely that $\delta_{ij} = 0$ and more shrinkage is attached by specifying the prior variance to be close to zero. This, in the next step of the MCMC algorithm, pushes the corresponding full conditional posterior of $c_{ij}$ to zero. The full prior setup as well as information in the Markov chain Monte Carlo algorithm is given in appendix A.

Finally, the sequence of $N + 1$ country models can be combined to yield a global VAR model,

$$\boldsymbol{G}\boldsymbol{x}_t = \sum_{n=1}^{p^*} \boldsymbol{F}_n \boldsymbol{x}_{t-n} + \boldsymbol{\eta}_t. \tag{8}$$

Hereby, we let $\boldsymbol{x}_t = (\boldsymbol{x}'_{0t}, \ldots, \boldsymbol{x}'_{Nt})'$ denote a $k = \sum_{j=0}^{N} k_j$-dimensional vector that collects all endogenous variables in the system, $\boldsymbol{G}$ is a $k \times k$ matrix of contemporaneous coefficients that are a function of the $\boldsymbol{B}_{i0}$ matrices and the weights in $w_{ij}$ and $p^* = \max(p, q) = 2$. Moreover, $\boldsymbol{F}_n$ are $k \times k$ matrices of autoregressive coefficients that are driven by the weights and the estimates of $\boldsymbol{A}_{ij}$ for all countries and $\boldsymbol{\eta}_t$ is a $k$-dimensional vector white noise process with a block-diagonal matrix $\boldsymbol{\Sigma}_t = \text{bdiag}(\boldsymbol{\Sigma}_{0t}, \ldots, \boldsymbol{\Sigma}_{Nt})$.

Multiplying with $\boldsymbol{G}^{-1}$ from the left yields the reduced-form GVAR model that closely resembles a standard VAR model with parametric restrictions imposed through the weights

$w_{ij}$,

$$\boldsymbol{x}_t = \sum_{n=1}^{p^*} \boldsymbol{\psi}_n \boldsymbol{x}_{t-n} + \boldsymbol{v}_t. \tag{9}$$

The reduced-form VAR coefficients are given by $\boldsymbol{\psi}_n = \boldsymbol{G}^{-1}\boldsymbol{F}_n$ and $\boldsymbol{v}_t$ is a $k$-dimensional vector of white noise errors with variance given by $\boldsymbol{\Omega}_t = \boldsymbol{G}^{-1}\boldsymbol{\Sigma}_t(\boldsymbol{G}^{-1})'$.

We impose no timing identification restrictions as done by most studies. Instead we calculate generalized impulse response functions (GIRFs) proposed in (Pesaran and Shin, 1998). This way we avoid the necessity to put identifying assumptions often not supported by theoretical predictions or empirical evidence. On the basis of our impulse responses we later construct generalized forecast error variance decompositions (GFEVDs) akin to Lanne and Nyberg (2016) in order to assess what drives the variation in our system.

In particular, we follow Pesaran and Shin (1998) and calculate GIRFs as:

$$GIRF_j(hor) = \mathbb{E}[\boldsymbol{x}_{t+hor}|\epsilon_{jt} = \sqrt{\sigma_{jj}}\mathfrak{T}_{t-1}] - \mathbb{E}[\boldsymbol{x}_{t+hor}|\mathfrak{T}_{t-1}] \tag{10}$$

where $hor$ is the horizon of the impulse response, $j$ is the variable from the original vector $x_{it}$ and $\mathfrak{T}_{t-1}$ is the information set before period $t$. Given this we calculate the GFEVD as:

$$\theta_{ij}(hor) = \frac{\sum_{l=0}^{hor} GIRF_j(hor)^2}{\sum_{j=1}^{k}\sum_{l=0}^{hor} GIRF_j(hor)^2} \tag{11}$$

In our analysis $\epsilon_j$ always corresponds to inflation. We calibrate it as a 1 percentage point increase in inflation.

## 3 Main hypotheses and related literature

Since our focus of interest is the conduct of monetary policy of highly interconnected economies practicing inflation targeting and to study the impact of global forces, let us now discuss the intuition and hypotheses of (i) the inflation equation and (ii) short term interest rate equation in our GVAR in more detail.

As inflation can be assumed to be a key signal for monetary policy in our set of countries, we are interested in the driving forces of inflation, measured by yoy growth of quarterly CPI, be it domestic or global. In our VAR, inflation is explained by the domestic factors such as output growth and monetary policy, and global factors, which are the inflation of trading partner countries, the exchange rate, the oil price, and trading partners output development and monetary policy rates.

First, the Phillips curve and Okun's law imply a positive relation between inflation and output growth. Inflation can be expected to increase over the business cycle due to wage pressures and scarcities when capacities get fully employed. In our inflation equation, this demand side aspect of inflation is considered by two variables measuring output growth: real output growth and development of equity prices $(\Delta y, eq)$.

Several studies tested this argument. Boschi and Girardi (2007) find in a structural VAR that in the euro area, inflation is partly driven by the output gap, partly by cost factors. Coe and McDermott (1997) propose that the output gap drives inflation in Asian countries. Mohanty and John (2015) using a time varying SVAR model find that the output gap is a major determinant of inflation in India in boom periods. Domaç and Yücel (2005) find that demand drives inflation in emerging markets, besides, food prices and fiscal policies. The pro-cyclicality of inflation seems to be sensitive to the time period considered (Primiceri, 2005; Cogley et al., 2010).

Second, according to the quantity theory of money, an increase of the nominal money supply above output growth results in a price increase. In our equation, this is considered by the variables interest rate ($i$) and term spread ($sp$), representing money growth. An increase of those is expected to lead to a decrease of inflation.

Third, when global linkages are considered, inflation should also be influenced by the price development in other countries from which intermediaries and consumer goods are imported, by developments of the exchange rate and of commodity prices, notably the oil price (cost push factors).[8] In addition, global output developments may affect inflation through demand effects on the domestic economy and the effect on global energy and commodity prices.[9]

Awareness that inflation today depends less on domestic factors but increasingly on global factors due to the inter-connectedness of economies, has risen. The BIS 2014 Annual Report stresses that recent inflation behaviour can be explained by accounting for global developments in input and factor markets, but also product markets since firms have to watch more closely the pricing of their abroad competitors when openness increases. Strong export economies are likely to experience a decline of mark-ups and lower inflation. Similar arguments are provided in Pain et al. (2006) who investigate the effect of globalization on OECD countries' inflation and find evidence that cheaper imports from emerging markets have lowered inflation. Furthermore, according to BIS (2015), Ciccarelli and Mojon (2005) and (Mumtaz and Surico, 2012), individual inflation rates increasingly contain a common component that follows a global business cycle. Already Ciccarelli and Mojon (2005) found in a principal component analysis that 70 per cent of inflation in OECD countries follows a common component.[10]

A specific global element of inflation arises from the development of commodity and energy prices. The literature on the influence of oil prices on inflation rates is manifold. Recent work by Choi et al. (2017) confirms a positive relation between oil price increase and inflation in

[8] Traditionally, the inflation literature distinguishes demand pull and cost push factors for inflation. The cost push view of inflation considers that inflation is determined by wage costs and import prices. In the empirical literature, Boschi and Girardi (2007), for example, propose that, besides the output gap, inflation is driven by the cost push factors wages and import prices. Alexova (2012), using a structural co-integrated VAR to analyze inflation drivers in CESEE in the period 1996-2011, proposes that mainly labour costs would drive inflation in Hungary, the Czech Republic and Poland, followed by import prices in second place. Due to data constraints we do not include wage costs in our model.

[9] Other factors determining inflation, often studied in the literature with developing countries, are public sector deficits which may lead to monetarization and thus raise inflation (Alexova, 2012; Mohanty and John, 2015; Saatcioglu and Korap, 2006).

[10] A related strand of literature investigates the effect of globalization, given by trade and financial openness, on the inflation level, for example Badinger (2009) and Gnan and Valderrama (2006).

advanced and developing countries but points out that the effect has become smaller over time and is asymmetric for increases versus decreases of oil price.

While existing studies have accounted for global factors of inflation by considering import or oil prices and exchange rates as global determinants of national inflation, this study considers more comprehensive and specific global factors likely to influence inflation. It includes:

- the specific inflation developments of all main trading partners to capture price developments of inputs and of competing final products ($\pi^*$);
- the exchange rate of an economy as well as exchange rates of trading partners to account for development of import prices ($er, er^*$);
- the oil price ($poil$) to account for price developments arising from the major commodity price;
- foreign output ($\Delta y^*$) and equity developments ($eq^*$) considered to represent the development in foreign demand and business cycle;
- foreign interest rates ($i^*$) and term spreads ($sp^*$) since they can be expected to affect relative exchange rate movements that would influence inflation.

The second variable of interest in our VAR concerns monetary policy. Already said, as a proxy, 3-months money market rates (like the euribor) are considered. We assume that interest rates are determined by an extended Taylor rule, where inflation ($\pi$) and output ($\Delta y, eq$) as well as exchange rate developments ($er$) are considered by monetary authorities.[11] In addition to domestic factors, the equations contain the global factors: interest rates, term spreads and output growth of trading partners ($i^*, sp^*, \Delta y^*, eq^*$).

That inflation rates guides monetary policy and thus our observed interest rates, can be expected as we consider a group of explicit or implicit inflation targeters.[12] [13]

We would also expect that this equation informs us which weight monetary policy puts. on output development and the currency value

Since in an open economy, the interest rate affects the exchange rate via the interest parity condition, Svensson (1999) proposes that CBs use a Taylor rule augmented by the exchange rate. A positive interest rate differential, e.g., of US dollar bonds relative to euro bonds would attract euro area investors and provoke financial outflows from the euro area. As a consequence, the US dollar should appreciate and the euro depreciate. Evidence can be found that the euro/dollar exchange rate follows its short-term interest differential. For the

[11] Note that in the strict Taylor rule CBs would set their interest rates according to deviation of inflation from a target and the output gap.

[12] In this sample, all advanced countries have officially or unofficially introduced IT in the 1990. In the euro area, which is bound to price stability, the Maastricht convergence criteria requested low inflation for joining EMU. The starting dates of IT of the other advanced countries are: Canada 1991, UK 1992, Australia 1994, Sweden 1995, Switzerland 2000, Norway 2001. The USA and Japan follow a price stability objective as the euro area. CESEE countries in our sample introduced IT between 1998-2001. Among our EMEs, Brazil introduced IT in 1999 and Mexico in 2001, Russia 2007. In China and India the focus on inflation started in 2002 and 2013 respectively, India adopting IT officially only in 2016, but China not yet so. (Combes et al., 2017; Jahan, 2017; Benes et al., 2017)

[13] Note that the Fisher effect would also postulate a co-movement between inflation and interest rates.

EMEs, according to Caporale et al. (2018), such an exchange rate augmented Taylor rule is requested to describe their interest rate setting. As our sample includes countries with fairly stable exchange rates and others with more volatile rates, we expect that the coefficient of the exchange rate in the monetary policy equation will be heterogeneous across countries.

In addition to domestic factors, it appears quite plausible that CBs take into account global developments as well (Del Negro et al., 2018). They might be guided by interest rate and output developments in other countries. For example, the ECB might consider the US interest rate policy and US growth. The interest policy because the interest differential to the USA will influence the Euro exchange rate and consequently EA exports and financial flows. The output development, first, since the output development is a guideline for the ECB which interest movement to expect in the USA, and second, because the EA output development signalled to ECB policy makers is influenced by the growth prospects in the US export market. Several arguments in this sense can be found in the literature. Hofmann and Bogdanova (2012) argue that particularly EMEs consider the movement of monetary policy rates abroad in order to avoid exchange rate movements and unwelcome capital flows. Bernanke et al. (2005), pointing to the Mundell Fleming trilemma, recall that the independence of EMEs monetary policy is limited if they wish to maintain a stable exchange rate. Furthermore, Defever et al. (2016), stressing the important interconnectedness of global economies through trade and financial markets, advocates that monetary policy has to consider the interest setting abroad because of exchange rate and export effects. They claim that moderate foreign growth and low foreign interest rates had prevented from early return to monetary normalization. On the other side, the US asset purchase program would not only have resulted in currency appreciations and lesser competitiveness abroad but other countries would have benefited from awaking US demand. Starting from these arguments well based in theory, we propose in this study that CBs will closely watch the interest rate policy of other countries in formulating their monetary policy.

# 4 Results

Our analysis covers 24 OECD economies plus major emerging market economies for the period 1995-2016. The estimates are based on quarterly data and data are taken from the IMF database and national sources.

First, we consider the impulse response of output and interest rates following domestic, inflationary shocks. We calibrate the shock to a 1 percentage point increase in domestic inflation and provide generalized impulse response functions in Figures 1 and 2. The figures show the posterior median along with 50% and 68% credible intervals.[14]

In general, interest rates increase as a consequence of a sudden rise in inflation. The increase in interest rates is modest in most advanced countries. A clear exception is the USA where interest rates react significantly to an inflationary shock. In a few countries interest rates decline and only rise with a considerable lag (Japan, UK). Since this reaction is robust

[14] Our credible intervals correspond to 25-75 per cent and 16-84 per cent credible sets, dark grey and light grey shaded areas respectively.

to different model specification (with or without oil prices) this reaction can be regarded as evidence that the Bank of England and Bank of Japan react comparably less to inflation than central banks in other advanced economies.[15] In contrast, for certain EMEs (Brazil, Mexico) and CESEE (Hungary, Poland) the increase in interest rates is substantial.[16] We consider the different extent of reaction of interest rates to changes in inflation as evidence that some CBs are more concerned about inflation than others.

The impulse responses show that as a consequence output generally decreases. The decline can be important in some advanced economies (Japan), including the euro area (Germany, Italy, Finland, Greece), and in Poland where the interest rate increase is strong. There are important exceptions from the negative reaction of output. In the USA, output increases despite the sharp increase in interest rates. In the euro area, despite ECB's interest increase, we find a most striking increase in output in Spain. Also in Ireland and Slovenia we see a positive response of output. It increases first slightly, before dropping. The puzzling decline of interest rates is followed by an increase in output in the UK. In most EMEs, except for Brazil, output increases (Mexico, India) or first increases before dropping (Russia, Turkey). Interestingly, the same countries show an increase of output across different model specification and estimation methods.[17].

Why should output increase despite raising interest rates? An obvious reason is that strong demand effects are linked with inflation in those countries so that output continues to increase or only drops with a delay after the interest rate increases. In the euro area, for the interest rate increase we found for the ECB, one has to remember that it is guided by developments in its major economies so that it would not sufficiently react to individual booms like in Spain or Ireland. In oil producing countries, the output increase associated with a rise in inflation may have another cause. Since inflation is also driven by oil prices, and rising oil prices would motivate oil production to increase, an additional output effect should arise.[18] Yet another argument for rising output has been proposed in the literature. Kozicki and Tinsley (2005) argue that if an inflation shock is perceived as permanent, CBs would increase their standard interest rate level and output would still grow.

### Determinants of inflation based on a generalized forecast variance decomposition

[15] Our period of study coincides with the zero interest rates period of Japan when the Bank of Japan was primarily focused on increasing inflation. It was operating with unconventional monetary policy tools. This can serve as an explanation for the inaction of the Bank of Japan on impact raise of inflation.

[16] The case of China is outstanding as we observe no reaction of its interest rates to the raise in inflation. China is the only country in our sample that does not follow an official inflation target. In fact, an official objective of the People's Republic Bank of China is the stability of its currency rate in order to facilitate economic growth. This suggests that China's central bank has other monetary policy objectives. Nevertheless, we find it important to include China into the analysis as it represents an important trading partner for many countries of our sample.

[17] We have carried out additional estimations which are available from the authors upon request. These cover for example impulse responses based on a Cholesky decomposition, as well as GVAR models with and without oil price and using the euro as an exchange rate numeraire.

[18] Indeed the output increase is higher in the USA in the model specification including oil prices.

We shall now turn to the determinants of inflation from a generalized forecast error variance decomposition (GFEVD). Technically, the forecast error variance decomposition is based on the posterior mean calculated as a running mean over all posterior draws of the regression coefficients of the GVAR. This is in contrast to standard procedures that calculate variance decompositions only for a point estimate of the GVAR coefficient (in a Bayesian setting the posterior median or in a classical setting the OLS estimate). Here, we do not ignore parameter uncertainty which improves upon existing studies. Moreover, as the shares of GFEVDs do not sum up to unity we employ the recently proposed normalization of Lanne and Nyberg (2016).

We will now discuss the results from two perspectives. First, we will group explanatories of inflation into domestic and global components. This will permit us to identify to which extent shocks to inflation are driven by domestic as opposed to foreign shocks. Second, we will discuss inflation from a functional perspective, namely to which extent forecast error variances are accounted for by previous inflation, foreign prices, exchange rates, demand factors and monetary policies.

In the short term, in most countries forecast error variance of inflation can be accounted for by domestic factors (see figure 3). The impact of domestic factors is distinctly lower in the euro area where it accounts for even less than 50 per cent in small and highly trading countries (Austria and Belgium, as well as Germany, France and Spain). Also in Switzerland the role of domestic factors for inflation has dropped to about 30 per cent. The role of domestic factors is much higher in the short run in advanced countries with big internal markets like the USA and Japan. Domestic factors are dominating shares of forecast error variance in CESEE and even more so in EMEs, where in the short run external factors are hardly important.

The diminishing role of global factors for inflation from advanced to CESEE economies and EMEs appears also in the long term. In most advanced countries, global factors account for some 80 per cent of forecast error variance of inflation in the long term. Exceptions are the USA, Japan, Norway, Greece and Slovakia. In CESEE, shares of explained forecast error variance associated with global factors amount to 50 to 80 per cent in the long term. In EMEs, the impact of global factors is below 50 per cent in the long run, in Russia and Mexico even below 20 per cent.

Our results are in line with ECB Economic Bulletin 2017 which proposes that on average in the euro area 50 per cent of inflation results from global factors.

The second way of discussing inflation determinants is from a functional perspective. We group inflation determinants into:

- Lagged domestic inflation to account for inflation persistence ($\pi_{t-1}$)
- Foreign price developments and currency variations as inflation drivers
  - Inflation of trading partners ($\pi^*$)
  - Oil price development ($poil$)
  - Fluctuation of domestic currency or currency fluctuations of trade partners ($er, er^*$)

- Demand proxied by output growth and equity price development:
  - Domestic demand ($\Delta y, eq$)
  - External demand ($\Delta y^*, eq^*$)
- Monetary policy proxied by short-term money market rates and term spreads (to account for unconventional monetary policy:
  - Domestic interest rate and term spread ($i, sp$)
  - Foreign interest rate and term spread ($i^*, sp^*$) as indicator for relative money growth.

The following patterns can be observed from the FEVD (see tables 1, 2, 3).

Domestic lagged inflation always accounts for most of forecast error variance in the short run. This indicates that inflation patterns generally show a high degree of persistence in the short run. High inflation in the beginning of the year will be followed by high inflation during the rest of the year. This persistence is particularly high in EMEs where 88-96 per cent of present inflation is explained by past inflation, but similarly high values above 86 are also found in the USA, Japan, Norway, Greece and Slovakia. Also in CESEE, lagged inflation explains between 61-79 per cent of present inflation. In contrast, lagged inflation is a much less important explanatory of present inflation in the other advanced countries and the euro area (explaining only around 13 per cent in Switzerland, 22-23 per cent in Spain, Austria and France). The high persistence of inflation in certain advanced countries and in EMEs can be explained by less openness and thus higher importance of national price setting and higher regulated price setting, like price controls. The same divide between advanced and emerging economies in inflation persistence is found in de Oliveira and Petrassi (2010). For India, also Mohanty and John (2015) find an equally high value of lagged inflation as in our results. For the advanced countries, an explanation proposed in the literature is that truly credible IT reduces inflation persistence (Kocenda and Varga, 2017).

In the long run (after 12 quarters), lagged inflation accounts for less than 10 per cent of forecast error variance in most advanced countries. Exceptions are the USA, Norway, Greece and Slovakia. The particular high persistence of inflation in these countries reflects high stability and low reversability of inflation. In CESEE and EMEs the impact of past inflation is higher, explaining in the long term between about 20 to almost 50 per cent of present inflation. As in the short term, the influence of past inflation is highest in Russia with 70 per cent, possibly reflecting high price regulation.

Shocks to foreign prices explain considerably forecast error variance of inflation in advanced countries (table 3). In the short term, in the euro area, foreign price developments account for up to 55 per cent of forecast error variance of inflation. Interestingly, the effect from foreign prices becomes weaker in the long term. Further, the effect is weaker in advanced countries with a large internal market (USA, Japan) or with low export openness (Greece). In CESEE and EMEs the impact of foreign price developments remains significantly lower, mostly below 5 per cent in the short term but increases, opposite to the sequence of influence of foreign prices on inflation in the advanced countries.

If we look more closely into these results (not shown in table 3 for sake of space), we observe that shocks to Russian inflation account for the largest share of foreign variables in the euro area, followed by shocks to US inflation. This reflects important linkages of euro area countries, Russia being a major energy supplier, the USA being Europe's most important export market. We find that in the USA and Canada, shocks to Mexico's inflation accounts for significant shares of forecast error variance of national inflation.

These results highlight on the one hand the importance of intermediary product supplies for advanced countries since their price development importantly affects domestic inflation. On the other hand, it also reflects that advanced economies are more active exporters and exposed to price competition. Such effects have been addressed in the literature. For example, Pain et al. (2006) propose that cheaper intermediary imports lowered OECD prices. Our results are novel compared to other studies stressing import price effects. While those are mostly restricted to testing the effect of exchange rates or consider general import prices of a country, our study explicitly considers the impact of inflation in trading partners' economies.

Shocks to inflation in the Brent oil price account for about 2-3 per cent of forecast error variance of inflation in most economies. This share increases in the long term by about one percentage point.[19] In self-extracting economies (Brazil, Mexico, Russia, Norway), shocks to inflation in the Brent oil price do not account for significant shares of forecast error variance of domestic inflation in the short term.[20] Only in the long term an impact appears.

Since variations in the exchange rate vis-á-vis the US dollar influence the price of imported goods, we expect that this factor also matters for inflation. We find such evidence in all our countries. In the advanced countries, including euro area core economies, this effect doubles after three years and accounts for about 10-20 per cent of forecast error variances. In some countries such as Austria, Switzerland and Finland, the exchange rate effect is already important in the short term, with 11, 15 and 12 per cent respectively, which increases further in the long term. Shocks to exchange rates are thus most important in the euro area core countries, in particular in Austria, Finland and the Netherlands.

Shocks to the exchange rate account for less forecast error variance of inflation in euro area periphery countries in the short run. In the long run, though shares are similar compared to those in euro area core countries. The same phenomenon is found in CESEE and EMEs. Particularly in China, the long-term effect of exchange rate changes on inflation is high and reaches 16 per cent. The different time pattern in these groups of countries in contrast to the advanced economies may be caused by exchange rate effects working on the export side and not on the import side. While exchange rate induced price changes with imports work immediately, changes through exchange rate effects on export revenues lead to different price setting behaviour in the long term.

[19] This result is in contrast to the finding of Choi et al. (2017) who reports that the effect of the oil price on inflation is no longer found after 2 years.

[20] Note that the Brent oil price index is higher than the Russian, Mexican and OPEC oil price.

To which extent can demand explain inflation? Table 1 shows that demand factors (domestic and global) account for the smallest shares of explained forecast error variance of inflation in the short run. In the long run, they are the third important factor in the advanced countries - with few exceptions, behind foreign prices and monetary policy factors. In CESEE and EMEs they are the least important factor in explaining forecast error variance of inflation.

From Table 2 we see that domestic demand accounts for only 1-7 per cent of forecast error variance of inflation in the short and long run. Particularly in CESEE economies (including Slovakia) and in EMEs, domestic demand accounts for higher shares of forecast error variances of inflation.[21] In the advanced countries domestic demand only sparsely explains inflation (e.g., in the USA and Germany).

In section 3 we mentioned that foreign output development can also generate demand-pull inflation. Evidence for such external demand-driven inflation is found in all countries (see Table 3). In the advanced countries, in contrast to the modest contribution of domestic demand for inflation, foreign demand plays a much more important role for inflation, in the short run and even more in the long run, accounting for 13 to 24 per cent of forecast error variance of inflation, with few exceptions below that value (e.g. Greece). Particularly in the small advanced economies like Switzerland, Austria, Finland, Netherlands and Ireland, the inflation impact of foreign demand is high, accounting for 18 to 24 per cent of forecast error variance of inflation. Also, in CESEE the impact of foreign demand on inflation is higher than the domestic, explaining in the long run 14 per cent of forecast error variance of inflation in Hungary and Poland. Also in EMEs, foreign demand explains more of forecast error variance of inflation than domestic demand (except for Russia) – in the long run 11 per cent in China and 16 per cent in Turkey.

In summary, foreign demand is a stronger driver of inflation than domestic demand in almost all countries examined.

Monetary policy factors (domestic and global) are generally, with few exceptions, the third most important factor for inflation in the short run, behind lagged domestic inflation and foreign prices, and the second most important factor in the long run (see table 1).

Domestic interest rate policy plays an almost equally low role for inflation as demand in the short run. However, in the long run, in some EMEs monetary rates, are the main driver of inflation, accounting for 27 per cent in Turkey, 24 per cent in Mexico and 29 per cent in China of forecast error variance of inflation.[22] Also in the Czech Republic and Hungary, shocks to interest rates are a major determinant with shares of explained forecast error variance of 13 per cent in the long term. In the euro area, shocks to interest rates account for about 6-7 per cent of forecast error variance of inflation in the long term in several small economies (Austria, Belgium, Ireland, Greece) and 9-13 per cent in several large economies (Germany, France, Italy). In the other advanced economies, short-term interest rates account for 2 per cent (UK) to 7 per cent (Japan) of forecast error variance in the long run. In general, these

[21] For India, an equally high impact of demand-driven inflation as in our results is also found by Mohanty and John (2015), but only for the non-crisis period.

[22] Also Huang et al. (2010) indicates liquidity as a major inflationary force in China

results are an indication that money supply matters for inflation and inflation targeting is thus an important framework for these countries, especially the EMEs.

Other countries interest rates are also found to play a role for domestic inflation (see Table 3). In this case, domestic monetary development is regarded against foreign interest rate development, leading to inflation development relative to the reference country. Our results indicate that in all advanced countries and also in CESEE foreign inflation is much more influenced by foreign CBs interest policy than by domestic monetary policy, in the short and in the long run. In these countries, foreign interest rates often account for a much larger share of forecast error variance, than domestic interest rates. In particular, shocks to interest rates of major economies like the USA and the euro area matter for other countries. In EMEs, the picture is more mixed. In some countries, shocks to domestic interest rates account for larger shares compared to global interest rates (Mexico, China, Turkey), in others monetary policy abroad matters more (Brazil, India, Russia).

To conclude, in the long run (see Table 1), foreign prices are generally the most important explanatory of forecast error variance of inflation in advanced countries. Only in a few advanced countries internal price persistence dominates inflation development (Greece, Slovakia). Monetary policy factors (domestic and global) generally account for the second largest share of forecast error variance of inflation in advanced countries in the long run. In contrast, in most EMEs, domestic past inflation accounts for most of forecast error variance in inflation. Only in China and Turkey, monetary policy factors (domestic or global) explain most of forecast error variance of inflation. In CESEE, all considered factors tend to contribute equally to explaining shares of forecast error variance of inflation, with some dominance of monetary factors. As indicated in Table 1, demand factors (domestic and global) show the smallest shares in the short run. In the long run, they are the third important factor in the advanced countries - with few exceptions, behind foreign prices and monetary policy factors. In CESEE and EMEs, they are the least important factor for inflation.

### Determinants of short-term money market rates based on a forecast error variance decomposition

Short-term interest rates, our indicator for monetary policy[23] are considered in our model to be explained among other factors by:

- Lagged domestic interest rates and term spread $i_{t-1}, sp_{t-1}$ as indicator for recent movements in domestic monetary policy

- Other domestic factors: Inflation $\pi$, output development (indicated by output growth $\Delta y$, development of equity prices $eq$) and exchange rate $er$.

- Global factors: foreign money market rates $i^*$ and term spread $sp^*$ as proxy for foreign monetary policy; foreign output development, indicated by foreign GDP growth $\Delta y^*$

[23]We are aware that short-term interest rates may deviate from the interest rates set by CBs if the interest pass-through is distorted.

and equity development $eq^*$; foreign exchange rates $er^*$, foreign price development $\pi^*$ and oil prices $poil$.

According to Figure 4, the FEVD indicates that in the short run, shocks to domestic factors account by far for the largest share of forecast error variance of interest rates (over 90 per cent in most countries, except for Canada, Japan and the UK). In most EMEs, domestic factors clearly dominate also in the long run. In contrast, in advanced countries, global factors determine over 50 per cent of forecast error variance of interest rates in the long term.

Tables 5 and 6 allow to look at the determinants of forecast error variance in more detail.

In the short run, (see Table 5) the FEVD show that past interest rates explain from about 70 to far beyond 90 per cent of forecast error variance of interest rates, irrespective whether it is the euro area, the USA, transition countries or EMEs. Only in a few advanced countries like Canada and the UK this effect is somewhat lower. In the long term (see Table 5), forecast error variance of interest rates is explained to a significantly lower extent by an autoregressive part. Past interest rate policy explains about 20 per cent in most advanced countries, except in the euro area where its contribution is 51 per cent. A higher persistence of interest rates is found in CESEE and EMEs, ranging from 31 per cent in Hungary to 100 per cent in China.

Among the other domestic factors accounting for forecast error variance of interest rates, shocks to domestic prices, output and the exchange rate appear in almost all countries in the sample (see Table 5).

In the advanced countries, about 2 per cent of interest rate movements can be explained by output development in the short term and in the long term. Particularly in the euro area and Switzerland, shocks to output explain a larger share of forecast error variance (12 and 7 per cent, respectively). But also in the USA and the UK (both 5 per cent) shocks to output play a more important role. In the euro area, a closer look at the explanatory factors (not indicated in Table 5) shows that shocks to output in Germany, France and Italy explicitly explain, in addition to the lagged interest rate, forecast error variance of short term interest rates.

The co-movement of short-term interest rates and output development in advanced countries may be considered as evidence that CBs are concerned about output developments in their monetary policy. Such interpretation would coincide with the finding of Svensson (1999) and Markov (2015) that output is prominently guiding monetary policy in industrialized countries.

For CESEE economies and EMEs we find a more heterogeneous relation between output development and interest rates. In some countries, shocks to output explain forecast error variance of interest rates to a high extent, for example in the Czech Republic (6 per cent), Mexico (8 per cent) and Russia (6 per cent), in other countries to a lesser degree (e.g., in Brazil, China and Turkey).

Domestic inflation, in the short term, hardly plays a role for short term interest rates in advanced countries (see Table 5). In the long term, domestic inflation explains a higher share of forecast error variance in advanced countries such as in the USA and in the euro area.

However, here a large share of forecast variance can be explained by shocks to foreign prices (including oil prices) in the long term (8 - 16 per cent, see Table 6). For example, in total, price developments (domestic and foreign) determine 12 per cent of forecast error variance of interest rates in the USA and 10 per cent in the euro area in the long term. In contrast, in CESEE and EMEs, domestic price developments are partly significantly more relevant. This applies for Hungary, Poland (explaining both 7 per cent of interest rate), Brazil (3 per cent), Mexico (11 per cent ) and Turkey (6 per cent). Foreign price developments and the oil price are only equally important as in advanced countries in Hungary, Poland (10 and 12 per cent) and Brazil (8 per cent). In other EMEs foreign prices explain a lesser share of forecast error variance. In total, in the long term, price developments thus account for a large share of forecast error variance in Hungary by 17 per cent and of Poland by 19 per cent, 11 per cent in Brazil and 13 per cent in Mexico. Moreover, since prices are also influenced by foreign exchange rate developments, monetary authorities are likely to consider also exchange rate development of main trading partners when deciding about a rate change. The FEVD shows that forecast error variance of interest rates is explained to a similar extent by shocks to exchange rates and foreign prices. In advanced countries and in CESEE, shocks to foreign exchange rates account for 5-13 per cent of forecast error variance (see Table 6) in the long term. For the USA and the euro area, this share is about 7 per cent.

Thus we have to conclude from our estimations that in our sample, price developments shape interest rate movements (except for China). Interest rates are strongly driven by movements in prices – taking the impact of domestic and foreign prices together – in Canada, Sweden, the UK, Hungary and Poland, followed by Norway, Mexico, the USA, Brazil, the euro area, Japan and Turkey. Also if taking all price and exchange rate movements (domestic and of trading partners) together as indicator for price concerns of monetary authorities, it appears that in the same countries, Canada, Sweden, UK, Hungary and Poland, CBs are most concerned about inflation, followed by, Norway, Mexico, Switzerland, USA, Japan, Brazil, Turkey, the Czech Republic and the euro area. Taking this broader view of price factors, we find no clear pattern whether monetary policy in advanced countries, CESEE or EMEs is more concerned about inflation. This differentiates our findings of the IR where interest rates increased stronger to inflationary shocks in CESEE and EMEs.

The development of the value of the domestic currency is practically always explaining a large share of forecast error variance of interest rates, irrelevant whether we look at advanced countries, CESEE or EMEs. Exceptions are the USA, Canada, the euro area, Switzerland and Norway. As we measure the dollar exchange rate, it evidently cannot appear as a determinant with the USA. In a number of countries, irrelevant of which country group, exchange rates explain a more significant part of forecast error variance of interest rates: Australia (6 per cent), UK (7 per cent), Czech Republic, Mexico, India (all 10 per cent) in the long term. This finding extends the conclusion of Calvo and Reinhart (2000) who found for 39 advanced and EMEs in the period 1970-1999 that monetary authorities manage exchange rates so that free floating currencies are in fact non-existing, with an exception of the dollar, yen and German mark.

Among the global factors influencing domestic interest rates, foreign output growth and foreign interest rates appear with all countries (see Table 6). Particularly in the advanced countries and in CESEE, foreign growth and even more foreign interest rates account for significant shares of forecast error variance of interest rates in the long term. In the long term, 5 per cent (Czech Republic, euro area) to 34 per cent of national interest rates is driven by foreign output growth. In general, the value lays above 10 per cent. In EMEs, this remains below 10 per cent.

Given the strong interdependence of financial markets and the implications of the interest rate parity condition, all CBs consider closely foreign interest movements. In our exercise and in the long term, foreign interest rates are the most important international factor. In Canada, Australia and Japan, national interest rates are determined by more than 40 per cent by foreign interest rates. In the UK and in Brazil, the contribution reaches almost 30 per cent. In the USA it is 16 per cent and in the euro area 12 per cent. A closer look at the results - not shown in the tables - shows that in particular CESEE and EMEs follow US and euro area interest rates, which is in line with Hofmann and Bogdanova (2012) and Feldkircher et al. (2016). We have to conclude that countries are obviously anticipating the exchange rate effects that would arise from changing interest rate differentials.

In summary, our findings suggest that interest rates are shaped by a multiplicity of domestic and global factors. Among the domestic factors, with practically all countries, domestic inflation, output growth and exchange rates appear as most important variables. In advanced countries, shocks to output account for a particularly large share of forecast error variance, while in other countries shares of domestic inflation, output growth and exchange rate development are more balanced. Strikingly, we find that global factors are influencing interest rates by more than 50 per cent in many advanced countries. Particularly, foreign interest rates and foreign growth appear as important factors. In EMEs foreign factors account for much smaller shares of forecast error variance of interest rates. This, indirectly provides insights what drives CB interest policy. This is valuable since generally no such policy guidelines are published by monetary authorities.[24]

# 5 Conclusions

In this paper, we investigate the nexus between inflation and monetary policy considering explicitly the impact of global forces.

Estimating a GVAR, we obtained the following results. First, we observed the reaction of monetary policy and output to an inflation shock looking at the impulse responses. Since interest rates generally increase due to an inflationary shock (except for the UK and Japan), we conclude that monetary policy is concerned about inflation. A notable increase can be seen in the USA, euro area and in certain CESEE and EMEs. The consequence of raising

[24] An exception is the Bank of England which publishes guidelines for its interest rate policy. Interestingly, in the case of the UK, our results reflect the statement of the Bank of England of domestic and external indicators that should guide its interest policy, among them output growth, the exchange rate and developments in the USA, euro area and EMEs which we find also as most important factors in our estimations.

interest rates in reply to an inflation shock is a decline in output, unless a strong demand pull situation prevails. Our results suggest that an increase in euro area short-term rates disproportionately dampens output in Germany, Italy, Finland and Greece while not reducing Spain's overheating. Also in CESEE the negative response of output to an increase in interest rates is significant.

Consequently, we looked at the empirical determinants of inflation on the one hand, and monetary policy on the other hand, as provided by a forecast error variance decomposition.

These analyses suggest that in advanced countries, notably in the euro area, inflation is explained by about 50 per cent in the short run and even 80 per cent in the long run by global factors. In CESEE and even more so in EMEs, global factors have a much smaller impact on inflation.

Decomposing the inflation determinants in a functional way provides further insights.

First, we observe a persistence of inflation in the short run, particularly in EMEs and second also in CESEE, but much lesser in advanced countries. That persistence drops significantly in the long run after 12 quarters.

Second, we find that foreign price developments influence inflation notably in advanced countries, explaining 55 per cent of inflation in the long run. Furthermore, the oil price development is an evident factor for inflation in all countries of our sample. In addition, exchange rate development have an influence on inflation in all regarded countries explaining 10-20 per cent of inflation.

Third, we observe that next to those factors, monetary policy is an important determinant of inflation, particularly in the long run. In several EMEs it is even the main factor driving inflation. This provides evidence that IT is a helpful monetary policy framework to watch inflation. For EMEs it is crucial to stabilize inflation.

Fourth, our results suggest that demand factors are the least important determinant of inflation.

Our estimations also permit to identify the factors explaining variance in short-term interest rates, and thus of monetary policy. While domestic factors clearly play a dominant role in EMEs, in advanced countries, this is only true in the short run. In the long run and in advanced countries, shares of global factors are particularly large.

Distinguishing different functional determinants of short-term interest rates, we observe in our estimations:

First, price developments influence interest rate movements (except for China). However, central banks watch domestic and foreign price developments when deciding on interest rates. Particularly in the advanced countries, shares of foreign price developments in explaining forecast error variance of interest rates are large, while in CESEE and EMEs domestic price developments dominate. Price developments are most important in Scandinavian countries, the UK, Mexico, Brazil, the USA, the euro area, Japan and Turkey.

Second, we find that high shares of forecast error variance of interest rates are explained by output, particularly so in the euro area, Switzerland, the UK and the USA. Moreover, exchange rates appear as an important determinant of monetary policy of most countries in our study. Noteworthy exceptions are the USA, Canada, the euro area and Switzerland.

Also, global output and interest rate developments play an important role for domestic interest rates. Clearly, for advanced countries and CESEE these shares are higher as these countries are more linked to the global economy.

We can conclude that the interaction between inflation and monetary policy is subject to considerable global influences, particularly in the advanced countries. Price developments in these countries are heavily influenced by foreign prices. From the perspective of a policymaker, this implies that central banks have to watch closely foreign interest and price developments when setting their own rates.

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# A Prior setup

This section provides further information on the priors for the GVAR model. For the indicators that control the mixture distribution, we impose a Bernoulli prior with

$$\delta_{ij} \sim Bernoulli(p_{ij}). \tag{12}$$

We set $p_{ij} = Prob(\delta_{ij} = 1) = 1/2$ for all $i, j$. This implies that a priori, all variables are equally likely to enter Equation 2. The scaling parameters are specified following a semi-automatic approach where the OLS standard deviation of a given parameter, denoted by $\hat{\sigma}_{ij}$, is used to construct $\tau_{ij,0} = 3 \times \hat{\sigma}_{ij}$ and $\tau_{ij,1} = 0.1 \times \hat{\sigma}_{ij}$

Similarly to the prior on the regression coefficients we impose a SSVS prior on the off-diagonal elements of $U_i$,

$$u_{ij,n}|\kappa_{ij,n} \sim \mathcal{N}(0, \varphi^2_{ij,n0})\kappa_{ij,n} + \mathcal{N}(0, \varphi^2_{ij,n1})(1 - \kappa_{ij,n}), \tag{13}$$

where $\kappa^2_{i,jn}$ is again a Bernoulli distributed random quantity that selects the mixture Gaussian component and $\varphi^2_{ij,n0}, \varphi^2_{ij,n1}$ are prior scalings such that $\varphi^2_{ij,n0} \gg \varphi^2_{ij,n1}$. For the scalings on the covariance parameters we follow George et al. (2008) and set $\varphi_{ij,n0} = 7$ and $\varphi_{ij,n1} = 0.1$.

Since prior information on inclusion/exclusion of a given covariance parameter is rather scarce, we again adopt a Bernoulli prior with prior inclusion probability set to $q_{ij,n} = Prob(\kappa_{ij,n} = 1) = 1/2$,

$$\kappa_{ij,n} \sim Bernoulli(q_{ij,n}). \tag{14}$$

We follow Kastner (2016) and impose a normally distributed prior on $\mu_{ij} \sim \mathcal{N}(0, 10^2)$, a Beta distributed prior on $\frac{\rho_{ij}+1}{2} \sim \mathcal{B}(25, 5)$ and a Gamma prior on $\varsigma^2_{ij} \sim \mathcal{G}(1/2, 1/2)$.

As mentioned in Section 2, our model collapses to a homoscedastic GVAR model if $\varsigma^2_{ij}$ equals zero. The Gamma prior on $\varsigma^2_{ij}$ is equivalent to imposing a normally distributed prior on $\pm\varsigma_{ij}$,

$$\varsigma^2_{ij} \sim \mathcal{G}(1/2, 1/2) \Leftrightarrow \pm\varsigma_{ij} \sim \mathcal{N}(0, 1). \tag{15}$$

This prior centers $\varsigma_{ij}$ on zero, if necessary and thus softly shrinks the model toward a homoscedastic specification, if necessary.

We sample from the $N + 1$ country-specific posterior distributions in parallel (where $N$ is the number of countries). The MCMC algorithm is standard in the literature for VAR models. Specifically, we sample $C_i$ on an equation-by-equation basis (for details, see Carriero et al., 2015) from an multivariate normal distribution. The off-diagonal elements of $U_i$ can be simulated by noting that the system can be rewritten as a set of $k_i$ univariate regression models with standard normally distributed errors (see Cogley and Sargent, 2005). The log-volatilities and the parameters of the state equation are simulated by means of the algorithm provided in Kastner (2016) and implemented in the R package stochvol (Kastner and Hosszejni, 2019). Finally, we sample the indicators $\delta_{ij}$ and $\kappa_{ij,n}$ from their Bernoulli distributed conditional posterior distributions.[25]

Finally, we specify the remaining hyperparameters for the prior. Specifically and following George et al. (2008), we set $\tau^2_{ij,0} = 3\hat{\sigma}^2_{ij}$ and $\tau^2_{ij,1} = 0.1\hat{\sigma}^2_{ij}$, where $\hat{\sigma}^2_{ij}$ are the OLS variances associated with $c_{ij}$. For the covariance parameters, we simply specify $\varphi^2_{ij,n0} = 3$ and $\varphi^2_{ij,n1} = 0.1$ for all $i, j, n$. We execute the MCMC algorithm for each country simultaneously and use 60,000 iterations with the first 30,000 being discarded as burn-in.[26]

# B Figures and tables

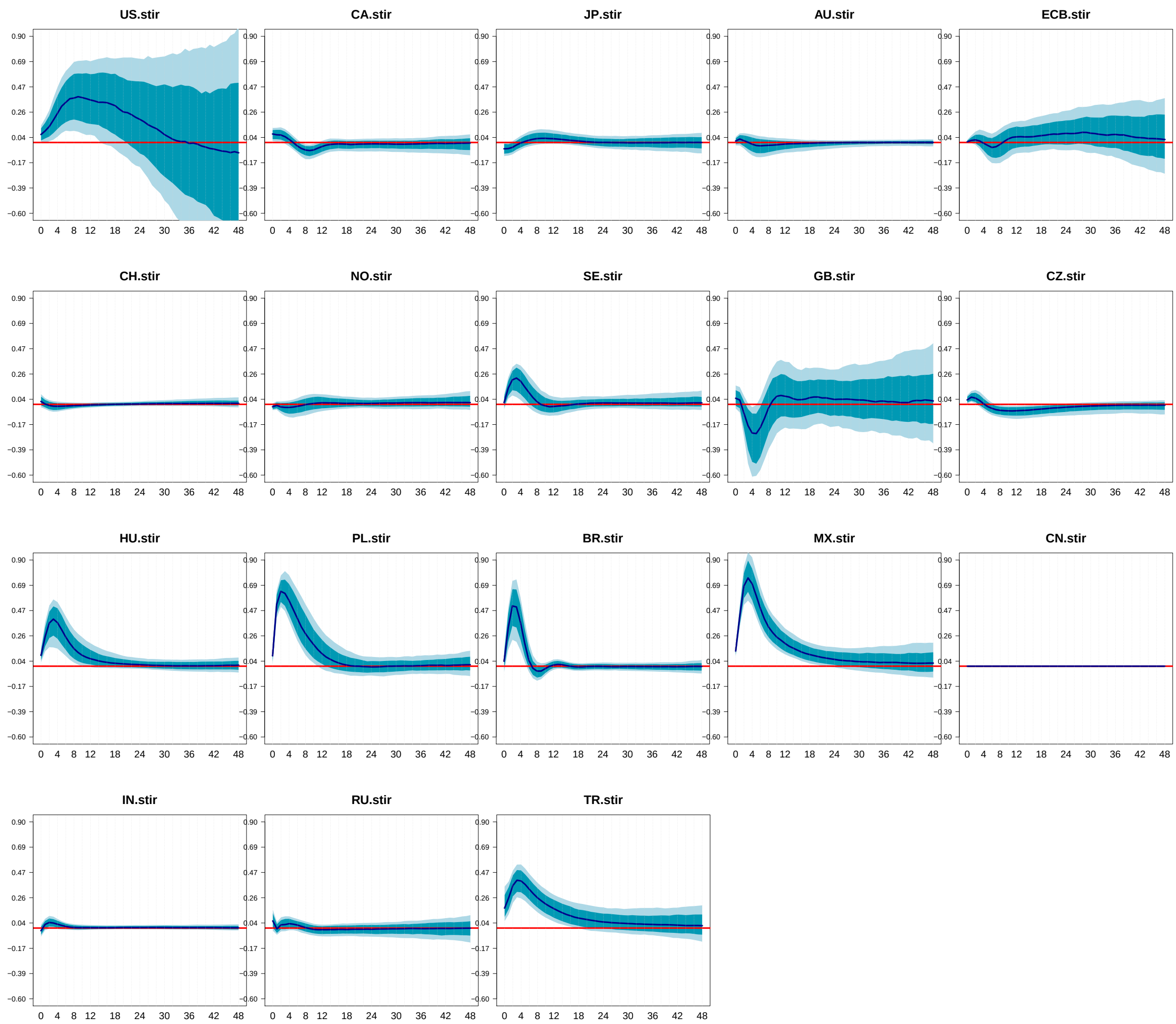



Figure 1: Impulse responce of interest rate to inflation shock

[25]For further information on the specific posterior moments, see Feldkircher and Huber (2016).

[26]Due to storage limits we use a thinning interval to select 6,000 out of the 30,000 posterior draws. From these, we sort out unstable posterior draws which are characterized by large eigenvalues of the companion form of the global model which leads to approximately 27% of the 6,000 posterior draws upon which the impulse response analysis in Section 4 is based.

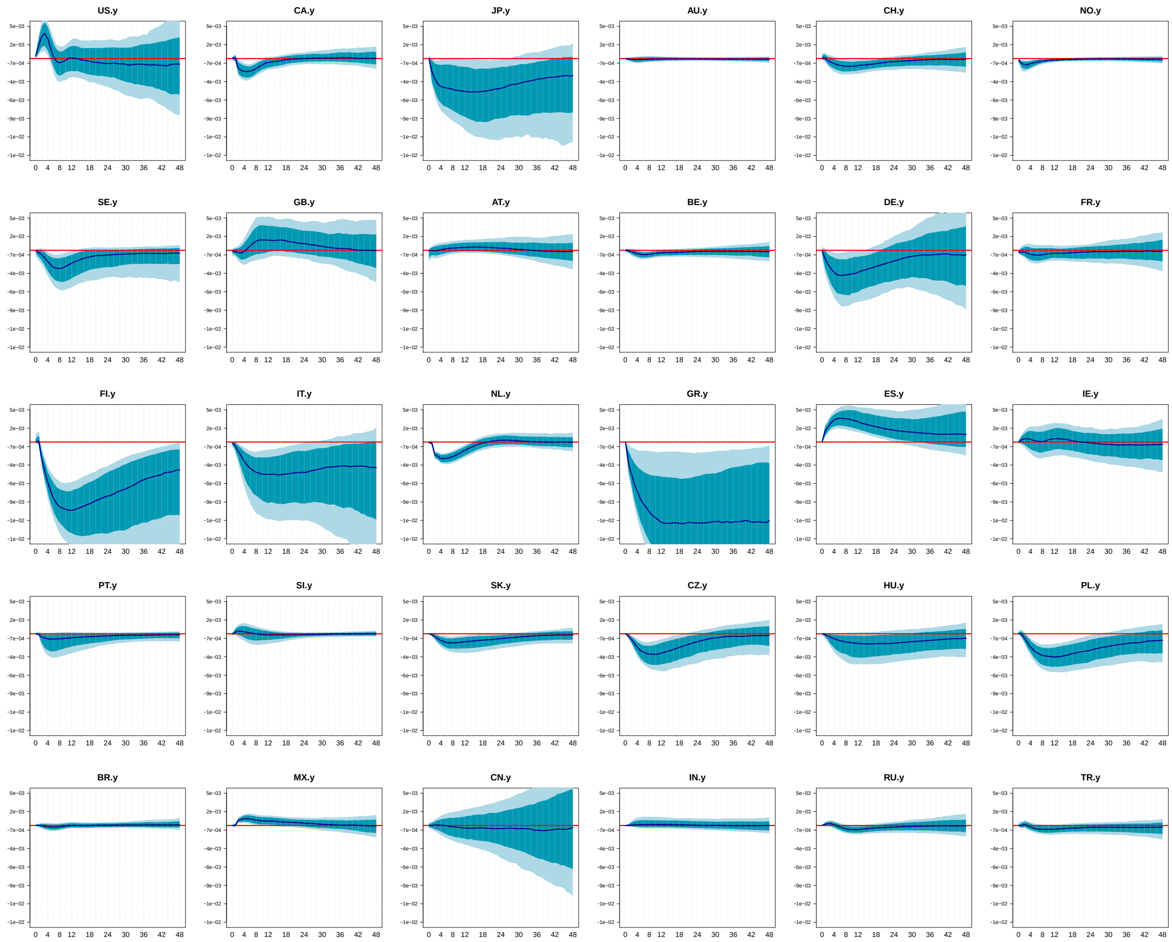
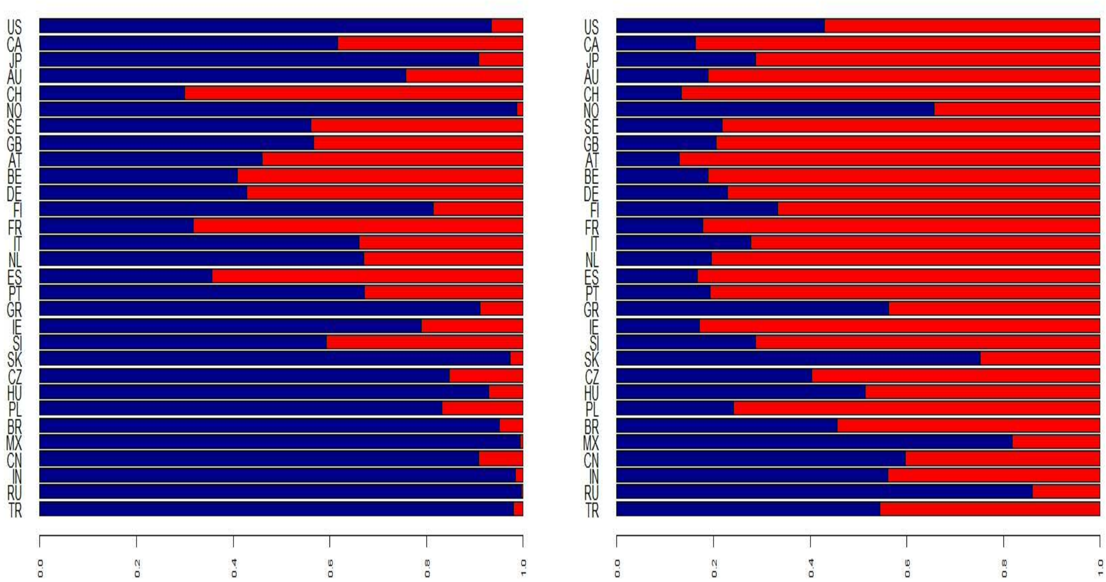
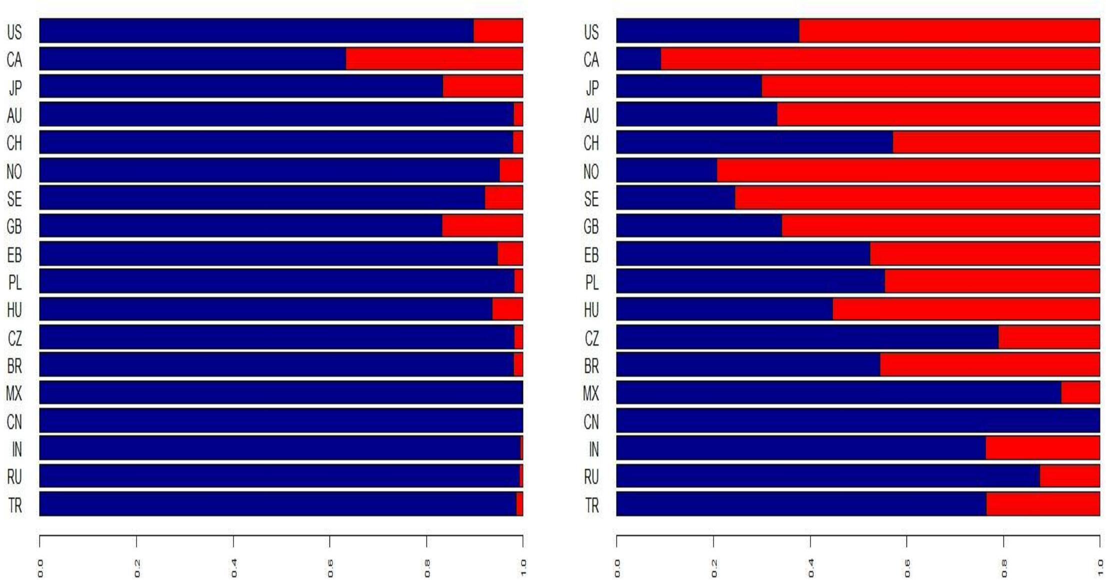



Figure 2: Impulse responce of output to inflation shock




Blue - domestic determinants of variation, Red - global determinants of variation

Figure 3: Forecast error variance decomposition of inflation, 1 period forecast horizon (left) and 12 periods forecast horizon (right)




Blue - domestic determinants of variation, Red - global determinants of variation

Figure 4: Forecast error variance decomposition of interest rates, 1 period forecast horizon (left) and 12 periods forecast horizon (right)

Table 1: Forecast error variance decomposition of inflation: Determinants of Inflation in Total

| | t=1 | | | | t=12 | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | Lagged domestic Inflation $\pi_{t-1}$ | Foreign prices & currency variations $\pi^*, er, er^*$ $poil$ | Demand (domestic & foreign) $\Delta y, \Delta y^*,$ $eq, eq^*$ | Interest Rate (domestic & foreign) $i, i^*,$ sp, $sp^*$ | Lagged domestic Inflation $\pi_{t-1}$ | Foreign prices & currency variation $\pi^*, er, er^*,$ $poil$ | Demand (domestic & foreign) $\Delta y, \Delta y^*,$ $eq, eq^*$ | Interest Rate (domestic & foreign) $i, i^*,$ $sp^*$ |
| **Advanced non EA** | | | | | | | | |
| US | 0,83 | 0,08 | 0,04 | 0,05 | 0,30 | 0,19 | 0,18 | 0,33 |
| CA | 0,39 | 0,48 | 0,04 | 0,09 | 0,10 | 0,39 | 0,18 | 0,33 |
| JP | 0,71 | 0,16 | 0,04 | 0,09 | 0,17 | 0,34 | 0,14 | 0,36 |
| AU | 0,50 | 0,27 | 0,07 | 0,17 | 0,06 | 0,27 | 0,17 | 0,50 |
| CH | 0,13 | 0,59 | 0,12 | 0,16 | 0,03 | 0,42 | 0,20 | 0,35 |
| NO | 0,85 | 0,06 | 0,06 | 0,03 | 0,54 | 0,17 | 0,13 | 0,16 |
| SE | 0,42 | 0,45 | 0,06 | 0,07 | 0,11 | 0,36 | 0,18 | 0,35 |
| UK | 0,37 | 0,45 | 0,06 | 0,12 | 0,08 | 0,39 | 0,17 | 0,36 |
| **EA core** | | | | | | | | |
| AT | 0,23 | 0,60 | 0,09 | 0,08 | 0,04 | 0,43 | 0,20 | 0,33 |
| BE | 0,29 | 0,61 | 0,04 | 0,06 | 0,10 | 0,44 | 0,15 | 0,31 |
| DE | 0,29 | 0,54 | 0,09 | 0,08 | 0,09 | 0,39 | 0,18 | 0,34 |
| FI | 0,60 | 0,22 | 0,08 | 0,10 | 0,15 | 0,32 | 0,26 | 0,27 |
| FR | 0,22 | 0,65 | 0,05 | 0,08 | 0,07 | 0,43 | 0,15 | 0,35 |
| IT | 0,47 | 0,40 | 0,05 | 0,08 | 0,12 | 0,38 | 0,15 | 0,35 |
| NL | 0,41 | 0,35 | 0,04 | 0,21 | 0,05 | 0,38 | 0,20 | 0,37 |
| **EA periphery** | | | | | | | | |
| ES | 0,23 | 0,61 | 0,07 | 0,09 | 0,06 | 0,45 | 0,16 | 0,33 |
| GR | 0,81 | 0,12 | 0,02 | 0,05 | 0,43 | 0,22 | 0,12 | 0,23 |
| IE | 0,58 | 0,28 | 0,10 | 0,04 | 0,08 | 0,40 | 0,24 | 0,28 |
| PT | 0,48 | 0,37 | 0,03 | 0,12 | 0,12 | 0,42 | 0,15 | 0,31 |
| SI | 0,48 | 0,42 | 0,05 | 0,05 | 0,16 | 0,38 | 0,16 | 0,30 |
| SK | 0,91 | 0,06 | 0,02 | 0,01 | 0,65 | 0,15 | 0,09 | 0,11 |
| **CESEE** | | | | | | | | |
| CZ | 0,61 | 0,20 | 0,06 | 0,13 | 0,20 | 0,31 | 0,14 | 0,35 |
| HU | 0,79 | 0,03 | 0,07 | 0,11 | 0,33 | 0,18 | 0,16 | 0,33 |
| PL | 0,68 | 0,11 | 0,04 | 0,17 | 0,12 | 0,36 | 0,19 | 0,33 |
| **EME** | | | | | | | | |
| BR | 0,88 | 0,05 | 0,01 | 0,06 | 0,35 | 0,26 | 0,09 | 0,30 |
| MX | 0,81 | 0,04 | 0,03 | 0,12 | 0,46 | 0,13 | 0,08 | 0,33 |
| CN | 0,78 | 0,09 | 0,07 | 0,06 | 0,23 | 0,24 | 0,11 | 0,42 |
| IN | 0,86 | 0,04 | 0,07 | 0,03 | 0,46 | 0,18 | 0,12 | 0,24 |
| RU | 0,95 | 0,02 | 0,02 | 0,01 | 0,70 | 0,08 | 0,10 | 0,12 |
| TR | 0,83 | 0,05 | 0,02 | 0,10 | 0,21 | 0,20 | 0,17 | 0,42 |

Table 2: Domestic determinants of inflation

| | t=1 | | | t=12 | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 |
| | Domestic inflation lagged $\pi_{t-1}$ | Domestic demand $\Delta y, eq$ | Domestic monetary policy $i, sp$ | Domestic Inflation $\pi_{t-1}$ | Domestic demand $\Delta y, eq$ | Domestic monetary policy $i, sp$ |
| **Advanced non EA** | | | | | | |
| US | 0,83 | 0,02 | 0,02 | 0,30 | 0,05 | 0,04 |
| CA | 0,39 | 0,01 | 0,02 | 0,10 | 0,01 | 0,03 |
| JP | 0,70 | 0,01 | 0,02 | 0,17 | 0,01 | 0,07 |
| AU | 0,50 | 0,01 | 0,04 | 0,06 | 0,02 | 0,06 |
| CH | 0,13 | 0,01 | 0,01 | 0,03 | 0,01 | 0,04 |
| NO | 0,85 | 0,05 | 0,02 | 0,54 | 0,04 | 0,03 |
| SE | 0,42 | 0,03 | 0,01 | 0,11 | 0,03 | 0,04 |
| UK | 0,37 | 0,01 | 0,02 | 0,08 | 0,02 | 0,02 |
| **EA core** | | | | | | |
| AT | 0,23 | 0,02 | 0,01 | 0,04 | 0,01 | 0,07 |
| BE | 0,29 | 0,00 | 0,01 | 0,10 | 0,01 | 0,07 |
| DE | 0,29 | 0,01 | 0,01 | 0,09 | 0,04 | 0,09 |
| FI | 0,60 | 0,01 | 0,01 | 0,15 | 0,02 | 0,08 |
| FR | 0,22 | 0,00 | 0,01 | 0,07 | 0,00 | 0,10 |
| IT | 0,48 | 0,01 | 0,02 | 0,12 | 0,01 | 0,13 |
| NL | 0,41 | 0,01 | 0,02 | 0,05 | 0,01 | 0,11 |
| **EA periphery** | | | | | | |
| ES | 0,23 | 0,00 | 0,02 | 0,06 | 0,01 | 0,09 |
| GR | 0,81 | 0,00 | 0,01 | 0,44 | 0,01 | 0,06 |
| IE | 0,58 | 0,01 | 0,01 | 0,08 | 0,01 | 0,07 |
| PT | 0,48 | 0,00 | 0,01 | 0,12 | 0,00 | 0,06 |
| SI | 0,48 | 0,01 | 0,01 | 0,16 | 0,01 | 0,10 |
| SK | 0,92 | 0,02 | 0,00 | 0,66 | 0,03 | 0,03 |
| **CESEE** | | | | | | |
| CZ | 0,61 | 0,04 | 0,08 | 0,20 | 0,03 | 0,13 |
| HU | 0,78 | 0,01 | 0,09 | 0,33 | 0,02 | 0,13 |
| PL | 0,68 | 0,02 | 0,02 | 0,12 | 0,05 | 0,03 |
| **EME** | | | | | | |
| BR | 0,88 | 0,00 | 0,00 | 0,36 | 0,00 | 0,01 |
| MX | 0,81 | 0,03 | 0,11 | 0,46 | 0,04 | 0,24 |
| CN | 0,78 | 0,00 | 0,02 | 0,23 | 0,01 | 0,29 |
| IN | 0,86 | 0,07 | 0,00 | 0,46 | 0,05 | 0,01 |
| RU | 0,95 | 0,02 | 0,01 | 0,70 | 0,07 | 0,04 |
| TR | 0,82 | 0,00 | 0,08 | 0,21 | 0,00 | 0,27 |

Table 3: Global determinants of inflation

| | t=1 | | | | | t=12 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| | Other Countries Inflation $\pi^*$ | Oil Price *poil* | Exchange Rate $er, er^*$ | Foreign Demand $\Delta y^*, eq^*$ | Foreign Monetary Policy $i^*, sp^*$ | Other Countries Inflation $\pi^*$ | Oil Price) *poil* | Exchange Rate $er, er^*$ | Foreign Demand $\Delta y^*, eq^*$ | Foreign Monetary Policy $i^*, sp^*$ |
| **Advanced non EA** | | | | | | | | | | |
| US | 0,04 | 0,03 | 0,01 | 0,02 | 0,03 | 0,08 | 0,03 | 0,08 | 0,13 | 0,29 |
| CA | 0,40 | 0,02 | 0,05 | 0,04 | 0,07 | 0,26 | 0,03 | 0,10 | 0,16 | 0,31 |
| JP | 0,03 | 0,05 | 0,08 | 0,03 | 0,08 | 0,08 | 0,04 | 0,22 | 0,13 | 0,29 |
| AU | 0,12 | 0,06 | 0,09 | 0,05 | 0,13 | 0,09 | 0,03 | 0,15 | 0,15 | 0,44 |
| CH | 0,34 | 0,10 | 0,15 | 0,12 | 0,15 | 0,19 | 0,05 | 0,18 | 0,18 | 0,31 |
| NO | 0,01 | 0,00 | 0,05 | 0,01 | 0,01 | 0,06 | 0,01 | 0,10 | 0,09 | 0,14 |
| SE | 0,36 | 0,04 | 0,05 | 0,04 | 0,06 | 0,19 | 0,04 | 0,12 | 0,15 | 0,31 |
| UK | 0,30 | 0,02 | 0,13 | 0,05 | 0,11 | 0,15 | 0,03 | 0,21 | 0,15 | 0,34 |
| **EA core** | | | | | | | | | | |
| AT | 0,46 | 0,03 | 0,11 | 0,08 | 0,07 | 0,26 | 0,03 | 0,14 | 0,19 | 0,26 |
| BE | 0,55 | 0,02 | 0,04 | 0,04 | 0,05 | 0,30 | 0,03 | 0,11 | 0,15 | 0,24 |
| DE | 0,47 | 0,02 | 0,05 | 0,07 | 0,06 | 0,25 | 0,03 | 0,11 | 0,14 | 0,25 |
| FI | 0,08 | 0,03 | 0,12 | 0,07 | 0,09 | 0,11 | 0,03 | 0,19 | 0,24 | 0,19 |
| FR | 0,55 | 0,04 | 0,05 | 0,05 | 0,07 | 0,28 | 0,04 | 0,12 | 0,14 | 0,25 |
| IT | 0,30 | 0,03 | 0,07 | 0,04 | 0,06 | 0,22 | 0,03 | 0,13 | 0,13 | 0,22 |
| NL | 0,30 | 0,01 | 0,04 | 0,03 | 0,18 | 0,21 | 0,02 | 0,14 | 0,19 | 0,26 |
| **EA periphery** | | | | | | | | | | |
| ES | 0,54 | 0,02 | 0,05 | 0,06 | 0,08 | 0,28 | 0,02 | 0,14 | 0,15 | 0,24 |
| GR | 0,02 | 0,03 | 0,07 | 0,02 | 0,04 | 0,08 | 0,03 | 0,11 | 0,11 | 0,17 |
| IE | 0,22 | 0,02 | 0,04 | 0,09 | 0,03 | 0,17 | 0,03 | 0,19 | 0,23 | 0,22 |
| PT | 0,32 | 0,01 | 0,04 | 0,03 | 0,11 | 0,24 | 0,02 | 0,16 | 0,15 | 0,24 |
| SI | 0,36 | 0,03 | 0,04 | 0,04 | 0,04 | 0,23 | 0,02 | 0,13 | 0,15 | 0,20 |
| SK | 0,03 | 0,00 | 0,02 | 0,00 | 0,01 | 0,07 | 0,01 | 0,07 | 0,06 | 0,08 |

Table 4: Global determinants of inflation (Continued)

| | t=1 | | | | | t=12 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| | Other Countries Inflation $\pi^*$ | Oil Price *poil* | Exchange Rate $er, er^*$ | Foreign Demand $\Delta y^*, eq^*$ | Foreign Monetary Policy $i^*, sp^*$ | Other Countries Inflation $\pi^*$ | Oil Price *poil* | Exchange Rate $er, er^*$ | Foreign Demand $\Delta y^*, eq^*$ | Foreign Monetary Policy $i^*, sp^*$ |
| **CESEE** | | | | | | | | | | |
| CZ | 0,13 | 0,03 | 0,04 | 0,02 | 0,05 | 0,18 | 0,03 | 0,10 | 0,11 | 0,21 |
| HU | 0,01 | 0,01 | 0,02 | 0,06 | 0,03 | 0,07 | 0,02 | 0,10 | 0,14 | 0,20 |
| PL | 0,05 | 0,01 | 0,04 | 0,03 | 0,16 | 0,16 | 0,04 | 0,15 | 0,14 | 0,30 |
| **EME** | | | | | | | | | | |
| BR | 0,03 | 0,00 | 0,01 | 0,01 | 0,06 | 0,11 | 0,02 | 0,14 | 0,08 | 0,29 |
| MX | 0,00 | 0,00 | 0,04 | 0,00 | 0,01 | 0,02 | 0,01 | 0,10 | 0,04 | 0,08 |
| CN | 0,01 | 0,02 | 0,06 | 0,07 | 0,04 | 0,06 | 0,02 | 0,16 | 0,11 | 0,13 |
| IN | 0,00 | 0,00 | 0,03 | 0,01 | 0,03 | 0,05 | 0,02 | 0,11 | 0,07 | 0,23 |
| RU | 0,00 | 0,00 | 0,02 | 0,00 | 0,01 | 0,02 | 0,01 | 0,06 | 0,03 | 0,09 |
| TR | 0,01 | 0,01 | 0,04 | 0,02 | 0,02 | 0,05 | 0,02 | 0,13 | 0,16 | 0,15 |

Table 5: Domestic determinants of interest rates

| | t=1 | | | | t=12 | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | Lagged domestic monetary policy $i_{t-1}, sp_{t-1}$ | Domestic Prices $\pi$ | Domestic Exchange Rate $er$ | Domestic Output Growth $\Delta y, eq$ | LAgged Domestic Monetary Policy $i_{t-1}, sp_{t-1}$ | Domestic Prices $\pi$ | Domestic Exchange rate $er$ | Domestic Output Growth $\Delta y, eq$ |
| **Advanced non EA** | | | | | | | | |
| US | 0,71 | 0,01 | 0,00 | 0,02 | 0,23 | 0,04 | 0,00 | 0,05 |
| CA | 0,43 | 0,01 | 0,01 | 0,02 | 0,06 | 0,00 | 0,00 | 0,01 |
| JP | 0,70 | 0,01 | 0,02 | 0,02 | 0,23 | 0,01 | 0,02 | 0,02 |
| AU | 0,71 | 0,00 | 0,18 | 0,03 | 0,22 | 0,01 | 0,06 | 0,02 |
| CH | 0,82 | 0,00 | 0,02 | 0,12 | 0,46 | 0,00 | 0,01 | 0,07 |
| NO | 0,83 | 0,00 | 0,02 | 0,02 | 0,16 | 0,01 | 0,01 | 0,02 |
| SE | 0,73 | 0,01 | 0,08 | 0,02 | 0,17 | 0,01 | 0,02 | 0,02 |
| UK | 0,66 | 0,00 | 0,04 | 0,01 | 0,19 | 0,01 | 0,07 | 0,05 |
| **ECB** | 0,87 | 0,00 | 0,00 | 0,09 | 0,51 | 0,02 | 0,01 | 0,12 |
| **CESEE** | | | | | | | | |
| CZ | 0,79 | 0,00 | 0,11 | 0,07 | 0,60 | 0,01 | 0,10 | 0,06 |
| HU | 0,78 | 0,03 | 0,01 | 0,06 | 0,31 | 0,07 | 0,01 | 0,03 |
| PL | 0,84 | 0,06 | 0,02 | 0,03 | 0,39 | 0,07 | 0,03 | 0,03 |
| **EME** | | | | | | | | |
| BR | 0,93 | 0,02 | 0,01 | 0,00 | 0,45 | 0,03 | 0,03 | 0,00 |
| MX | 0,78 | 0,01 | 0,12 | 0,09 | 0,62 | 0,11 | 0,10 | 0,08 |
| CN | 1,00 | 0,00 | 0,00 | 0,00 | 1,00 | 0,00 | 0,00 | 0,00 |
| IN | 0,85 | 0,00 | 0,12 | 0,01 | 0,62 | 0,00 | 0,10 | 0,02 |
| RU | 0,91 | 0,00 | 0,01 | 0,06 | 0,75 | 0,01 | 0,04 | 0,06 |
| TR | 0,94 | 0,02 | 0,02 | 0,00 | 0,65 | 0,06 | 0,03 | 0,00 |

Table 6: Global determinants of interest rates

| | t=1 | | | | t=12 | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| | Foreign Growth $\Delta y^*, eq^*$ | Foreign Monetary Policy $i^*, sp^*$ | Foreign exchange rate $er^*$ | Foreign Prices $\pi^*, poil$ | Foreign Growth $\Delta y^*, eq^*$ | Foreign Monetary Policy $i^*, sp^*$ | Foreign exchange rate $er^*$ | Foreign Prices $\pi^*, poil$ |
| **Advanced non EA** | | | | | | | | |
| US | 0,13 | 0,04 | 0,02 | 0,07 | 0,16 | 0,36 | 0,07 | 0,08 |
| CA | 0,05 | 0,43 | 0,02 | 0,03 | 0,16 | 0,47 | 0,12 | 0,16 |
| JP | 0,03 | 0,20 | 0,01 | 0,01 | 0,13 | 0,42 | 0,07 | 0,09 |
| AU | 0,02 | 0,03 | 0,01 | 0,01 | 0,12 | 0,44 | 0,06 | 0,08 |
| CH | 0,03 | 0,01 | 0,00 | 0,00 | 0,16 | 0,17 | 0,06 | 0,06 |
| NO | 0,03 | 0,02 | 0,01 | 0,06 | 0,34 | 0,25 | 0,11 | 0,12 |
| SE | 0,04 | 0,05 | 0,03 | 0,04 | 0,24 | 0,29 | 0,10 | 0,14 |
| UK | 0,14 | 0,11 | 0,02 | 0,02 | 0,16 | 0,29 | 0,07 | 0,15 |
| **ECB** | 0,02 | 0,01 | 0,00 | 0,01 | 0,05 | 0,12 | 0,07 | 0,08 |
| **CESEE** | | | | | | | | |
| CZ | 0,00 | 0,02 | 0,00 | 0,00 | 0,05 | 0,10 | 0,05 | 0,03 |
| HU | 0,04 | 0,03 | 0,02 | 0,03 | 0,13 | 0,22 | 0,13 | 0,10 |
| PL | 0,01 | 0,02 | 0,00 | 0,01 | 0,10 | 0,18 | 0,07 | 0,12 |
| **EME** | | | | | | | | |
| BR | 0,00 | 0,04 | 0,00 | 0,01 | 0,07 | 0,28 | 0,05 | 0,08 |
| MX | 0,00 | 0,00 | 0,00 | 0,00 | 0,02 | 0,04 | 0,01 | 0,02 |
| CN | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| IN | 0,00 | 0,01 | 0,00 | 0,00 | 0,06 | 0,12 | 0,03 | 0,04 |
| RU | 0,00 | 0,01 | 0,00 | 0,00 | 0,02 | 0,09 | 0,01 | 0,02 |
| TR | 0,00 | 0,01 | 0,00 | 0,00 | 0,08 | 0,08 | 0,06 | 0,04 |